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Title of Proposal: Scaling Infiltration Measurements in Shrink-Swell Soils: Effects of Land Use and Landscape Position

Vertisols are high clay soils that change volume during natural wet and dry cycles. Vertisols cover approximately 2.4% of the Earth's surface (Soil Survey Staff, 1994). Within the United States, the largest percentages of Vertisols are found in Texas. These soils are intensely managed because of their economic importance to US agriculture and, in Texas, urban and suburban development. In Texas, an area of Vertisols known as the Blackland Prairie is classified as USDA prime farmland and encompasses two of the largest metropolitan areas in the country, Dallas/Ft. Worth and Houston, TX. Our management decisions regarding these soils have an impact on water storage, discharge, and particulate and solute transport from agricultural and urban areas. Hydrology models are commonly used to quantify the impact of management decisions on hydrology. These hydrology models do not work well without good representation of soil hydraulic properties, namely infiltration and saturated hydraulic conductivity (K_{sat}). Hence to improve our understanding of land use on hydrology we need better estimates of these soil physical properties. The proposed work is unique because it addresses the effect of landscape position, land use and soil properties on soil K_{sat}. Landscape position, land use, and soil properties (like presence of gilgai which occur in Vertisols) can be easily measured with remote sensing and GIS layers; hence these auxiliary pieces of information have the potential to improve estimates of K_{sat} without requiring further field-based measurement. Upon completion of the project we expect to be able to further refine current published K_{sat} values based on information readily gleaned from current GIS coverage's. In addition, we will develop a protocol for a smart-sampling strategy for future K_{sat} measurements, so that limited resources can be optimized to gather the most critical K_{sat} information in the field.

Various studies have shown that K_{sat} is temporally and spatially variable across a landscape. This variation is in part due to differences in antecedent soil moisture and the effects of macroporosity on infiltration rates (Messing and Jarvis, 1993; Lin et al., 1998; Gupta et al., 2006). Spatial variation in macroporosity and antecedent soil moisture can be linked to landscape position because of long term effects of landscape position on soil development. For example, landscape position effects soil properties such as erosion on steeper slopes, accumulation and deposition of colluvial and alluvial materials at toe slopes, and overall depth of soil development (West et al., 2007). We also expect antecedent soil moisture to differ according to landscape position because of runoff and infiltration on varying slopes (wetness index; Moore et al, 1993). Land use can have a significant effect on infiltration rates. As land use changes so do factors such as compaction from traffic, rooting depth and geometry, presence of microtopography (from gilgai formation), and soil structure. All of these factors have a significant effect of infiltration rates. Because of their strong shrink-swell potential, Vertisols have the ability to form very distinct microtopography and gilgai features. A Vertisol may be mapped as one soil type; however, within this microtopography, very distinct differences in the surface soil properties occur. These changes in surface properties significantly change water infiltration rates.

Nature, Scope, and Objectives of the Research

The ***overall objective*** of this research is to study of the effects of land use, landscape position and microtopography on infiltration rates, or saturated hydraulic conductivity (K_{sat}), and to develop a sampling a strategy for collecting K_{sat} values in future studies. The ***hypothesis*** of this research is that land use, landscape position and microtoprography have significant effects on K_{sat} values. Having a better understand of these effects can lead to better modeling of runoff, infiltration, and solute transport across a watershed. To test this hypothesis, measurements of infiltration will be conducted *in-situ* on watersheds of three different land uses, grazing, native prairie and row crop. At the completion of this study, we expect to have a better understanding of how land use, landscape position microtopography effect infiltration rates. The data collected from this project will be published and made available to the public through the USDA-NRCS. A sampling strategy will be developed for future studies on K_{sat}. Also guideline for altering published K_{sat} values for changes in land use or landscape positions will be developed.

Academic Qualifications

Courses Taken

Proposed Use of Funds

If awarded, the funds will be used for lab materials and textbooks. The funds will also be used for travel to the ASA-CSSA-SSSA annual international meetings for 2009 in Pittsburgh, PA to present my research.

Intended Career Path

Upon graduation I intend to pursue a career as a soil scientist in hydrology applications, either in the government or private industry. I am interested in looking into a career with the USDA Natural Resources Conservation Services in soil survey or soil conservation.